Today’s K-12 classroom contains students of diverse backgrounds and abilities. High-stakes assessments introduce additional pressures upon educators to raise the performance of all students to a high standard. In turn, educators are increasingly looking to adaptive technologies to help meet students’ individual needs.

Pearson SuccessMaker Math and Reading adaptive courseware has been helping educators meet those needs for decades. The product is continually updated with content reflecting the current educational standards yet the adaptivity is based on a proven research base.

SuccessMaker’s research foundations go back to the pioneering work on intelligent tutoring and artificial intelligence led by Professor Patrick Suppes at Stanford University beginning in the mid-1960s (Suppes, 1981). A guiding idea of this work is to develop a structured, comprehensive, and deep curriculum, to be presented to the individual learner in the manner and the rate best suited to that learner, as determined by the learner’s responses to the system. The synergy of curriculum and adaptivity had guided SuccessMaker development efforts over the years, providing the market with a unique adaptive solution where curriculum and adaptivity work seamlessly together since the curriculum has been specifically designed to work with the SuccessMaker adaptive engines.

The purpose of the research is to emulate a human expert tutor who discerns and responds to the individual instructional needs of each student and provides essential information to the classroom teacher. Although the computer cannot fully emulate the nuanced interactions between an educator and the pupil, the company’s ambition is to equip the classroom teacher with an instructional aid who is expert, affordable, and educationally effective by targeting critical foundational skills allowing educators to focus on core curriculum.

The primary guiding features of the SuccessMaker adaptive engine are the following:

- Decide where to begin instruction;
- Determine when the student demonstrates learning;
- Emphasize content appropriate to the student’s needs;
- Clarify points when difficulties arise;
- Remind the student of knowledge previously attained;
- Check the student’s recollection of previously mastered material.
The strands instructional strategy plays a key role in SuccessMaker, and its explanation is essential to a description of the SuccessMaker curricula. A strand represents one content area within a curriculum. For example, a division strand, a decimal strand, and an equation strand are three of the strands included in the Mathematics curriculum. Reading curriculum strands include Concepts of Print, Phonics, Fluency, and Vocabulary. Each strand is a string of related learning objects whose difficulty progresses from easy to difficult, spanning grades K–8 as appropriate. One unique feature of SuccessMaker adaptivity is that within any single student courseware session, students will receive a mixture of different types of items instead of a series of similar items. This mixture of items helps to maintain student interest over the course of the session since the student cannot predict what type of question will come next, minimizing tedium. The mixed presentation of items across strands also limits rote memorization and increases long-term retention since the student will experience the item over a longer duration (generally several sessions) helping to move the item from short-term memory to long-term memory.

The strand based structure of the content is vital for item mixed presentation. A second necessary component is that the student is working at their overall construct ability level. To that end, SuccessMaker utilizes an adaptive initial diagnostic at the beginning of the course to place students at the courseware level that best represents the point where a student is ready to learn.

Research has shown that this overall ability level metric, in conjunction with the strand structure, allows for the student to receive varied content for which the student is ready to learn, creating an engaging and efficacious learning environment for the student.
SuccessMaker employs a sophisticated mastery model. Item mixed presentation allows the student to interact with several skills during a single session, but student history for each skill is separately maintained. For each skill, the courseware generates a set of equivalent exercises that differ with randomly selected variables and graphic presentations. Student performance for any single exercise is monitored using a performance vector where each attempt is recorded. Skill mastery determination is evaluated after every attempt and incorporates the number of attempts, pattern of attempts (where more recent attempts receive greater weight) and use of supports. That way students spend only as much time as needed to represent mastery, and to move on to additional content in a highly efficient manner as performance dictates.

Specifically in SuccessMaker Math, the student’s understanding of a learning objective is formulated as a probability that the student will correctly respond to the next exercise pertaining to the objective. This probability is updated based on the sequence of student responses according to the following assumptions:

1. The student’s most recent response, if correct, indicates an increased probability of success on the next exercise;

2. The student’s more recent responses are better indicators of the student’s current understanding than are earlier responses.

One key feature of SuccessMaker Math is that each item is assigned to a mastery table of values. In addition to determining the required answer pattern to represent item mastery, the mastery table values determine when item interventions are required. Not all mathematical items are equal in how they are best learned and the mastery table values enable varied mastery strategies to be selected for each item.

SuccessMaker Reading adaptivity varies from SuccessMaker Math, in accordance with construct differences, but the basic core adaptive principals remain. The Reading course is lessons based where lessons are constructed with grouped learning objectives. Subsequent lessons presented to the student will reflect student performance, allowing a student to receive additional scaffolding and practice as needed or to move on to the next lesson as performance dictates.
Interventions.

Mixed item presentation is a key SuccessMaker adaptive learning strategy and has proven itself throughout the years. But sometimes a focused, non-fixed presentation of items is the more prudent strategy. SuccessMaker employs several other intervention strategies. A student can initiate an intervention by accessing one of several support tools such as the glossary or conversion tables. A student can also initiate a tutorial designed to provide background instruction. Finally, a student request that the solution of the problem is worked out for them.

System generated interventions include item specific scaffolded instruction (immediately generated upon a wrong response). Item answer patterns will dictate the presentation of a tutorial, a series of prerequisite items or a sequential presentation of the item (to allow for a targeted practice environment). After completion of the intervention phase the item is returned to the mixed presentation mode.

One additional intervention made possible by the dynamic sequencing of content is when a student experiences repeated difficulties with new material, the material is set aside (“delayed”) for subsequent presentation.

Again, the goal is to challenge the student without frustrating him, and thereby to keep him engaged in the courseware.

SuccessMaker also includes a retention phase to help students remember previously completed content. To help with long-term retention of an item, previously completed content is reviewed systematically after a segment of additional content is completed where a thin slice of the original content is presented to the student for one final practice (review).
Movement through any segment of the course will include a consistent set of content. This consistency can be leveraged to generate how long a student will need to reach a targeted courseware level based on the current individual performance of the student compared against prior performance of thousands of students. This predictability allows for scheduling to be modified at the individual student level to better achieve courseware attainment goals.

**Conclusion.**

SuccessMaker is a proven adaptive solution Math and Reading. In education, “adaptivity” has become a common term with many products claiming to be adaptive but one critical difference between SuccessMaker and the others is that in SuccessMaker the adaptivity is incorporated as part of curriculum design. This allows for a highly efficacious student learning environment because curriculum and adaptivity work seamlessly together. SuccessMaker is a highly researched program, consistently representing positive student outcomes. The synergy of SuccessMaker content with its sophisticated adaptivity algorithms has driven us to become the premier supplemental adaptive solution for K–8 Math and Reading.